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Deeper

What is an agricultural engineer?

In 1904, a group of educators defined him as one who lays out farms, designs and constructs farm buildings and works, and makes and uses farm implements.

Today, agricultural engineers go far beyond this. They establish basic principles as well as determine techniques and specifications for applications of engineering to farming.

Traditionally, of course, agricultural engineers have largely done applied research. They've taken the results from other fields of science and translated them into workable plans; developed power and equipment; helped put fertilizers and pesticides on every farm; designed structures and irrigation systems; developed processing and marketing facilities. It's a record to be proud of—and one to be continued.

Fortunately, some agricultural engineers have gone beyond application and testing techniques. These men followed in the footsteps of men like Michael Faraday and Joseph Henry. In a day when conventional research on illumination may have involved developing better lamp wicks, Henry and Faraday discovered the principles of electromagnetic induction.

It's this kind of pioneering research that has been the starting point for most of the scientific advances in agriculture and elsewhere—and offers the greatest promise today.

We've solved many agricultural problems by applying established scientific principles—with a small amount of new basic research here and there. But we've also failed in many instances because we haven't had enough basic knowledge.

We must take a broader and deeper approach. Consider the farm tractor. We know, for example, that tractor tire design can contribute to soil compaction. We need to learn more about the relationship of soil conditions to plant growth; the effects of tires and tracks and the stresses they impose on the soil; the distribution of forces applied to various soils by tools of different shapes and materials.

That's an example of the sort of effort we must make to meet the challenge of finding new uses for today's output, improving efficiency, and producing enough in the future.

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EXPERIMENTAL wheat (left) with short, stiff straw has lodging resistance and other merit, while typical commercial wheat (right) lodges badly.

SEMIDWARF WHEAT SHOWS PROMISE

Crosses of Japanese and American wheats produce well on fertile land without lodging

SHORT, STIFF-STRAWED WHEATS that can be grown without lodging on fertile soil with heavy nitrogen fertilization are being developed and are under test in cooperative research by USDA and the Washington, Oregon, and Idaho Agricultural Experiment Stations.

The best of these experimental wheats still is not up to the standards of commercial wheats in all respects. With good luck, however, in finding experimental lines that have largely overcome the major shortcomings, the scientists may be able to make a productive lodging-resistant wheat available to growers by 1963 or 1964.

Winter wheat varieties in the Pacific Northwest may grow 5 to 6 feet tall on fertile land during years favoring rank vegetative growth, a cause of severe losses from lodging and disappointing grain yields. To reduce these losses, cooperating USDA and State researchers are developing wheats with very short straw, notably less subject to lodging. The most promising plant type now appears to be the semidwarf, which is intermediate in height between the grassy true dwarf and the presently grown short-strawed commercial varieties.

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SEMIDWARF WHEAT SHOWS PROMISE

(Continued)

The new type was developed by crossing commercial varieties and experimental selections with a short semidwarf Japanese wheat, Norin 10. It was introduced into this country 12 years ago and was used in crossing because it grew only one-half as high as standard tall varieties and the straw stood erect. It is not suitable itself for commercial use in this country because it is partially male sterile, susceptible to important diseases and is not winterhardy.

New wheats resist lodging, make high yields

Promising combinations of lodging resistance, semidwarf growth habit, and high grain yields showed up in the cross of Norin 10 x Brevor, made and tested by ARS agronomist O. A. Vogel and a team of State and Federal researchers in the Pacific Northwest.

Selections 14 and 17 from this cross proved most outstanding in yield trials in Washington and Oregon. These selections had normal flowering habits and therefore their varietal purity could be much more easily maintained than was possible with the partially male-sterile Norin 10. However, neither of the two selections was suitable for commercial production in the Pacific Northwest because they were low in milling quality, highly susceptible to mildew and leaf rust, and emerged very poorly from deep early-fall seedings. Their greatest value was as parents in new crosses designed to improve their reliability and efficiency of production.

New crosses with high-yielding soft white winter wheats have produced several semidwarf selections highly resistant to common and dwarf bunt and moderately resistant to current races of leaf rust and powdery mildew in the Pacific Northwest. However, none of these semidwarfs emerge satisfactorily from deep early fall seedings. That seriously limits their usefulness, particularly in early seedings on summer fallow, where it is also important to obtain sufficient ground cover to prevent serious water erosion during the winter rainy season. These wheats also need further bred-in protection from other yield-reducing hazards, such as winter injury and leaf, stem, and root diseases.

Slow but steady progress is being made toward improving the milling and baking qualities of the semidwarf wheats. The best selections are not as good in these qualities as the white club varieties, but are equal or noticeably better than some of the important commercial soft white common varieties. However, quality testing has been done on a very limited scale, and dependable ratings must await future trials.

Semidwarfs are being sought for many areas

These wheats are adapted only to the higher rainfall areas of the Pacific Northwest. However, Japanese, Korean, and European semidwarfs are being used extensively throughout the country in Federal-State cooperative wheat breeding work still in the early stages.☆

Methods ENGINEERING for Large DAIRIES

■ Traffic control for cows? It looks like the coming thing. Large dairies are fast becoming more widespread. Just getting the cows to and from the milking area can result in bovine congestion serious enough to give a dairyman a traffic cop's headache. Time and travel studies should help break this bottleneck.

This is only one of the difficulties being faced on large-scale dairy operations, such as cow pools. USDA agricultural engineer Thayer Cleaver found from a cooperative study with the University of California, Davis, that there's urgent need for engineering improvements to assure efficient production by such dairies.

Concentration of many dairy cows, equipment, and labor into fairly small areas only intensifies design, investment, labor-management and sanitation problems. For instance, most large dairies (400 to 1,500 cows) operate on hired labor. Thus, up-to-date engineering methods for labor efficiency are a must if dairymen expect to stay in business.

Care of cows and efficiency can depend on milkers' fatigue. For example, 3-year records of a 960-cow dairy in California showed the herd could produce more milk and be milked faster and with less labor in elevated rather than floor-level stalls. Production differences were due largely to the extra care given cows in elevated stalls by milkers, who weren't as tired because they didn't have to squat or stoop.

Production difference between the two systems was enough so that the new system paid for itself in less than a year through the additional milk the cows gave.☆

Crosses with grass introduced from South America raise hopes for a highly resistant variety within the next few years

RYEGRASS with RUST RESISTANCE

CLONES of experimental ryegrass hybrid have been exposed to rust inoculation. Those that developed no rust were bagged prior to blooming to assure self-fertilization.

A PROMISING ANNUAL ryegrass hat's highly resistant to crown rust as been developed for the South by SDA in cooperation with the Mississippi Agricultural Experiment Station, and is now undergoing tests.

This experimental rust-resistant strain was derived from South American introductions from Uruguay. Development of that grass was begun in late 1951 by ARS plant pathologist H. W. Johnson at McNeil and continued cooperatively with ARS-State agronomist H. W. Bennett and State agronomist C. L. Blount.

Several rows of the Uruguayan introductions were planted along with several rows of domestic ryegrass, as a check, and rust was allowed to develop naturally. The South American introductions proved to be relatively rustfree. The domestic variety was highly susceptible to rust.

UST-RESISTANT plants like this are self-pollinated for everal generations to segregate out all susceptibility genes.

Resistance was introduced

Using a scoring system that ranged from 1 for slight rust to 5 for severe rust, all rows of domestic grass scored 5. The Uruguayan introductions scored only 1 or 2. Seeds of the Uruguayan introductions were then planted in a greenhouse and the resulting plants were inoculated with rust. From 35 to 51 percent of the plants from this seed showed rust resistance, an indication to Johnson that the rust resistance of the introductions could be improved through selection and inbreeding.

With this start, Johnson put these plants through several generations of selfing, selection, and test-growing

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INOCULATION with crown-rust spores exceeds nature's resistance test. If no rust shows, plants have resistance genes, may have masked susceptibility genes to be bred out.

RYEGRASS with RUST RESISTANCE

(Continued)

under intense exposure to rust at Stoneville. Some plants were grown outdoors and allowed to intercross. Others were grown in the greenhouse and artificially inoculated with rust. Plants remaining rustfree were transplanted to the field and individually self-pollinated. By the fall of 1955, five lines ranging from 83 to 100 percent rustfree had been developed. These were combined as an experimental strain and sent out for regional plot trials.

The selection and self-pollination were continued for a few more generations of accelerated breeding in the greenhouse and field. Three resultant lines tested 88, 91, and 96 percent rustfree. These were combined to form a second experimental strain and sent out for regional tests in the fall of 1957. Complete immunity to crown rust may never be reached but Johnson feels that a highly resistant variety is possible within the next few years. Seed is available now for plot tests only.

States also work on problem

Similar work is also underway with ryegrasses from various other experiment stations in the south. Each station annually sends 10 to 15 pounds of seeds of its experimental strains to Beltsville, Md., where they are distributed on a request basis to other stations wishing to test the strains in their areas. In these regional tests, the seed is planted in small plots for yield tests and disease resistance studies. Information from these tests is then used by the various States in making recommendations for the release of a new variety and in recommending varieties for growing in their States.☆

HOW MANY SEEDS ARE SET?

■ BLACK GRAMA GRASS' seed-setting abilities can now be correctly determined with a simple, fast, and inexpensive new research-based technique.

Black grama is an important Southwestern range grass with many desirable characteristics. Its use for range reseeding is limited, though, because it's such a notoriously poor seed producer, and because so little information is available on factors affecting seed set.

We do know, however, that black grama *can* produce economical seed yields with the proper combination of irrigation and insecticides. And with the new technique, we now have a way by which we can tell how *much* seed can be set under these ideal conditions. This opens the way for intensive study of seed-set performance.

One of the difficulties in studying black grama's seed-setting characteristics is the tendency of the mature florets to shatter with the slightest handling. And when this happens, the seed-filled florets can't be related to the parent seedhead. USDA scientists decided that the best procedure would be to determine the number of florets—

CYTOGENETICS of black grama is checked by L. J. Streetman at Tucson laboratory. Studies are also underway here on mode of reproduction, seedling drought tolerance, range conditions.

eed carriers and potential seed carriers—right on the ndividual seedheads.

Agronomists L. N. Wright and L. J. Streetman of the ARS Forage and Range Research Laboratory, Tucson, Ariz., harvested the mature seedheads before the seed hattered, and sealed them in water-filled jars to be processed later when convenient. Samples were thus tored at room temperature for 6 months with no ill effects. One to two cubic centimeters of a 1-percent formaldehyde solution protected against bacterial action.

When the scientists were ready to count the seeds, the storage water was poured off and replaced with 250 cc. of tap water and 2 cc. of a bleach, making up an 0.8-percent sodium hypochlorite solution. Bleaching action was complete within 48 hours. Seedheads were stored in this solution for 3 months with no ill effects. Seed counts were made with the help of a magnifier-illuminator. The sodium hypochlorite bleached the floral parts enclosing the seeds so they could be counted easily. A solution of less than 0.5 percent didn't bleach enough. And a solution of 1.25 percent bleached floral parts and seed beyond easy recognition.

This technique is highly accurate as the seeds don't shatter. And the fact that samples can be stored for so long and processed when convenient makes it even more useful. Scientists point out, however, that the seeds won't germinate after treatment. Thus, the technique is limited to determination of seed setting.

Wright and Streetman feel, though, that the technique can be used with other grasses and perhaps legumes for determination of seed setting, although the sodium hypochlorite concentration may have to be varied.☆

IT PAYS TO INCORPORATE SOME FAMILY FARMS

Operators of family farms may find they can realize sizable tax savings by adopting a hybrid type of fiscal management for their farm business—operating as a corporation but paying taxes as a partnership.

Federal income tax laws now permit certain small corporations—both farm and nonfarm—to elect to be taxed as partnerships while retaining all the advantages of incorporation. A USDA study shows the dual status enables large tax savings for many small farm corporations that otherwise could not avoid double taxation on their net returns—a tax on income of the corporation and a further tax on the same income when distributed as dividends to shareholders.

This hybrid tax status is open to most U.S. (domestic) corporations that issue only one class stock and have no more than 10 shareholders. Shareholders must be U.S. residents, and the consent of all is needed before a partnership tax status can be adopted by their corporation.

ARS farm economists, in studying the advantages of this dual type of management, cite the considerable tax savings that are possible with the partnership tax option. The option allows shareholders to assume the tax obligation on their respective shares of the corporation's current taxable income, whether distributed or not. This income thus becomes exempt from the corporate tax and subject only to personal income tax. Consequently, there would be an overall tax break for incorporated farms because the tax rate on shareholder income should be lower than the rate on that amount of corporate income.

Example compares two setups

The size of the tax saving is clearly shown by checking how a farmer and his wife who are sole shareholders of an incorporated farm would fare, taxwise, with and without the option. If they should net $30,000, the corporate tax would be $10,100. The individual income tax on the remainder of the $30,000 distributed as dividends would be $3,466 (assuming no additional income or exemption, and a 10-percent allowance for nonbusiness deductions). So the couple's combined corporate and individual income tax would total $13,566. But taxed as a partnership, they would pay only $7,574 and save 44 percent.

Greater saving on small income

A corporate net of $7,500 would result in combined corporate and individual taxes totaling $2,800. But treating this amount as partnership income, the couple would pay just $1,141, a saving of 59 percent.

There are genuine advantages, of course, in the corporate management of a family farm. But until now these gains may not have been strong enough to sway many sole proprietors and partners. Eliminating double taxation of corporate income may well convince some farmers to take another look at incorporation as a means of efficient management.☆

Improvements in equipment enable us to spray plants more completely with less chemical, to better evaluate the time of pest emergence and extent of the infestation, and to minimize damage to the crop

TRACTOR-MOUNTED offset boom sprays cotton in skip-row field. Unit uses skipped rows, doesn't damage foliage.

Tightening Cotton

■ IMPROVEMENTS IN COTTON insect control are coming from USDA engineering and entomology research.

Among proven advances are new spraying devices and methods. In Mississippi, for example, side-mounted booms on trailing-type sprayers gave good results in spraying four-in, four-out (skip-row) cotton. Skip-row is the alternating of four-row strips with equal unplanted strips. The sprayers operate in the unplanted strip.

Results of preliminary tests with a mist sprayer, which airblasts fine particles across the tops of plants as far as 90 feet, appear promising for both insect control and defoliation. The mist sprayer was first developed for use in orchards, where large areas of foliage had to be covered from the ground.

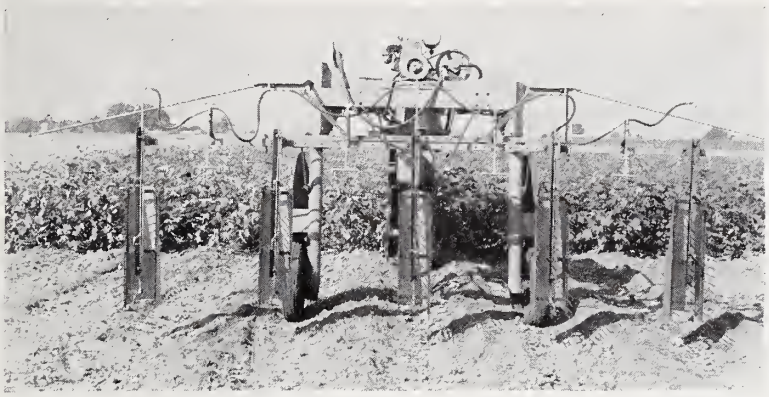
In cotton production, the mist sprayer's advantage lies in its ability to apply material from the edge of the field or in planned roadways 60 feet or more apart. This is an important factor in wet weather and heavy growth to reduce damaging traffic over wet ground.

DESTRUCTION trap has 400-watt mercury vapor lamp to lure insects, which are drawn into bag by suction fan, killed in process. For survey work, to assure identifiable insects, fan is removed.

Spraying muddy fields is being facilitated

Low-pressure tires for surer footing of high-clearance sprayers in muddy fields are being tested by ARS scientists at Stoneville, Miss., in cooperation with the USDA Tillage Machinery Laboratory, Auburn, Ala. It is important to spray the cotton crop at planned intervals and sometimes promptly after rain to forestall new outbreaks of

THOROUGH coverage is assured with nozzles placed to spray from above and below (left) in trailing-boom sprayer (below). Spray is placed on hard-to-reach leaf undersides, and foliage is agitated more thoroughly with bi-directional spraying. Result: far more complete coverage, important in checking such pests as mites.



CLOUD of mist from airblast sprayer reaches 60 feet into field. For thorough job, unit sprays again from another row.

INSECT Controls

pests and diseases. Some of the chemicals will have been washed off and the moist conditions favor development of insects and diseases.

We can cover plants better with less spray

Better pesticide distribution systems for both ground and aerial sprayers enable us to spray more efficiently. Nozzle-placement studies are yielding much more precise coverage with less insecticide and less residue.

In California, ARS engineers developed a nozzle system for spraying cotton for mites, from both the top and underside of the leaves (AGR. RES., February 1959, p. 11). This idea offers better control for some types of cotton insects, including spider mites. In Oregon, dusting or spraying to cover both top and bottom of the leaves has been done to control potato aphids.

Recent studies have found ways of helping prevent spread of pink bollworms in ginning. Gin fans developed by ARS engineers killed all pink bollworms in gin trash and in linters, motes, and hulls. Specifications for the fans have been approved by the ARS Plant Pest Control Division as pink bollworm quarantine requirements.

ARS scientists also found that all worms in infested seed were killed by the standard acid or mechanical-flame process for delinting and the hot-water treatment for hastening germination. The water treatment involves immersing cottonseed at temperatures between 160° and 180° F. for 1 to 2 minutes. Seed delinted at approved acid or mechanical-flame delinting plants or given the approved hot-water treatment for hastening germination may now be certified for movement out of the pink bollworm quarantine area without further treatment.

Because of the high pink bollworm kill in normal ginning and the further kill in processing seed for oil or treating it for planting, complete worm kill in cottonseed is less important when the seed is used within the infested area. Texas and New Mexico thus no longer require heat treatment of cottonseed at gins.

Better traps aid pest sampling and control

ARS scientists are working to develop better survey-trap devices, too. They are trying to find bands of ultraviolet light that will attract a wide range of insects, and to develop "fine-tuning" techniques for attracting only single species. Thus far, however, they have found no wave length that attracts the boll weevil although the adult pink bollworm and cotton bollworm moths are attracted by the near-ultraviolet range.

Ultraviolet light is already used to attract insects and reveal just how many pests there are in the area and the time of emergence. That helps determine proper control. The light is being used as an attractant for both electrified grid traps and the new suction fan traps that collect insects in a mesh bag.☆

There's been no good way to determine yarn's contraction in weaving—an important index to quality—but

Now we can measure COTTON CRIMP

REVOLUTION of wheel during weaving marks off 18 inches; beginning and end are marked with colored yarn. Difference in original and woven yarn length indicates the crimp measure.

■ AN ACCURATE NEW DEVICE for determining how much cotton yarn contracts (crimps) when woven into cloth holds interest for both researchers and manufacturers.

Yarn crimp—which greatly influences strength, flexibility, and abrasion and tear resistance of cotton fabrics—is important to researchers in developing new fabrics, and to manufacturers in weaving new patterns.

Actual crimping is caused by interlacing of threads in a cloth. And the difference in yarn length before and after being woven is the measure of crimp. Up to now, there has been no really satisfactory way to determine this important index to cotton quality.

The new measuring device—developed by cotton technologists E. C. Kingsbery and N. P. Roddy of USDA's Southern Utilization Research and Development Division, New Orleans—consists mainly of a shellacked hardwood wheel 18 inches in circumference, mounted on a plywood frame. (Shellac gives traction when the wheel turns with the warp.) The wheel is held firmly against the warp by a 3-pound weight suspended beneath the loom and fastened to the frame by a rope-and-spring connection to prevent bouncing due to the loom's rocking motion.

A small piece of yarn of a different color from that in the loom is inserted in the fabric being woven. The measuring wheel is set at zero, weaving is started and continued until the wheel comes back to zero—a distance of 18 inches. Another piece of colored yarn is inserted and normal weaving is continued. When the cloth is removed from the loom, the distance between the two colored yarns is measured. From these measurements—knowing the original yarn length to be 18 inches—the percent of crimp is easily calculated.

Crimp needs vary with different fabrics

There isn't any single ideal crimp value, say the ARS researchers. For best performance, different fabric constructions require different crimp values. Oxford and duck cloths, for instance, are woven from highly crimped yarn. Voiles and organdies, on the other hand, are woven from low-crimped yarn.

The effects of yarn crimp on cotton quality can be explained in part by crimp's behavior in the fabric.

A tightly woven or highly crimped fabric, for example, means that the yarns have less mobility and thus tend to be stiff and inflexible. A high crimp in both the warp and woof yarns means that both of the yarns are equally exposed on the fabric surface and will have a high resistance to abrasion.

Fabric strength is affected by crimp, too, but by *distribution* rather than by percent of crimp. Stressing a fabric straightens the horizontal threads and causes the crimp to transfer to the cross yarns. If these latter yarns jam at the yarn intersections before this can happen, fabric strength is greatly reduced.

Tear resistance is also determined largely—but in a little more complicated way—by yarn crimp. Basically, fabrics with a large number of threads per given area have a high crimp and low resistance to tear.

Fortunately, once the new device has been used to forecast how much a yarn *will* crimp, simple adjustments can then be made on the loom roller to correct for any deviation from the desired amount of crimping.☆

CALVES, DIETS and PARASITES

Degree of infection is seen more important than feed in recent tests

CONTINUING USDA WORK is shedding more light on the relation of diet and internal parasitism of calves.

New studies show that the *degree of infection*—as acquired by calves from single doses of larvae—is more important than diet in determining the ill effects of parasitism.

For example, parasite-free calves fed standard alfalfa hay (U.S. No. 2) or a legume-grass mixture gained about 10 percent more per pound of feed consumed than those on fescue. But moderately or heavily parasited calves either lost or gained at about the same rate regardless of diet. Neither the alfalfa nor the legume-grass mixture was sufficiently superior to fescue to prevent the weight losses and serious internal injuries caused by heavy parasitism.

Conditions differ in new work

These results seem to contrast in part with past work, which showed that parasite-infected calves on fescue pasture had more worms or showed more ill effects of worm infection than calves on a temporary pasture mixture or crimson clover (AGR. RES., June 1957, p. 6). But these tests were conducted on parasite-contaminated pastures and cattle were continuously exposed to reinfection as they grazed at will. Thus, neither the degree of parasite infection nor the amount of feed consumed was controlled.

In the recent tests, however, parasite-free calves were infected with only *single* doses—from moderate to heavy—of common larvae. In addition, feed intake was controlled.

Parasitologist Aaron Goldberg of the ARS Agricultural Research Center, Beltsville, Md., placed various lots of parasite-free calves on fresh fescue, second-cutting fescue hay, standard alfalfa hay, or a fresh legume-grass mixture (mostly clover, lespedeza, and orchard-grass). Half the calves were later infected with known different numbers of common parasite larvae, and half were kept parasite-free as controls. Comparisons were made between animals on each diet before and after infection.

Effect of heavy doses severe

Calves getting the heaviest doses of larvae were the most seriously affected regardless of diet. All calves developed a high fever, several died within a few days, and the rest went into a coma within 40 days.

When animals received the same dose of parasite larvae, there wasn't any real difference in effect of diet on weight. Rate of gain was more affected by the *size* of the infection than by diet differences.

Comparably infected animals showed pretty much the same clinical symptoms and pathological changes—lack of appetite, abnormal stools, weight loss, and in severe cases, bloody lesions in the intestinal tract.

However, 16 percent more worms were recovered at autopsy from animals fed fescue than from those on the other diets, and about 1.8 times as many eggs were passed in the feces. This may have been due to the poorer nutritive quality of the fescue. From the standpoint of injury to the host, this difference in number of worms was almost insignificant at the levels of infection in these tests.

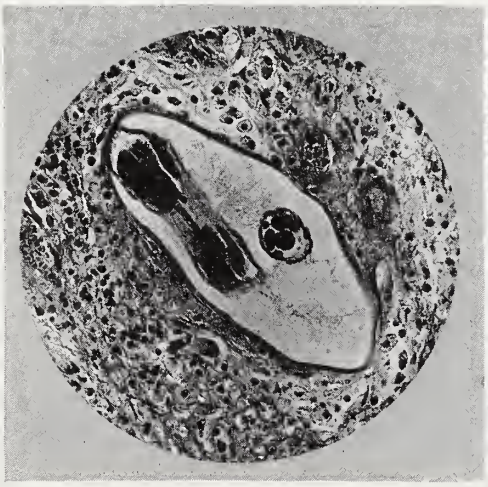
More larvae found on fescue

If the calves had been on pasture, those fed fescue would have added much more to contamination of the pasture than the calves on the other diets. This agrees with previous findings that more infective larvae are found on fescue pastures than on others comparably grazed.

Age of host is important, too. Younger animals in the experiments were more seriously affected by the worms than were older animals.

Rate of development of worms wasn't affected by diet difference.☆

NODULAR worm larva—*Oesophagostomum radiatum*—imbeds itself deeply into the small intestine of parasite-infected cow.



SICK CALF shows typical emaciation characteristic of heavy parasitization with both stomach and intestinal worms.

OUR DIETS ARE CHANGING

We use fewer calories—but a wider range of foods containing more of some nutrients

■ MANY CHANGES in our national food supply have taken place in the past 50 years. Some have come about because technological advances in agriculture and marketing have increased the quantities and kinds of foods in the market. Others reflect changes in demand—higher incomes have enabled more people to buy the kinds of foods they want. Furthermore, people have become more aware of the importance of nutrition.

ARS food economist Berta Friend points out that we now have not only a wider variety of foods but more per person of some that supply essential nutrients—foods such as milk and milk products (other than butter), meat, poultry, and eggs. We are also eating, on an average, more green and yellow vegetables, tomatoes, and citrus fruits, but less of many other kinds of fruits and vegetables, especially potatoes and sweet potatoes. On the other hand, consumption of grain products has moved steadily downward until it is now only one-half as great as in 1909.

Today's food supplies provide fewer calories—about 3,200 per person per day as compared with 3,600 calories in 1909—following the general reduction in physical activity and caloric needs. Not as many people are doing heavy labor and the proportion of elderly persons is rising.

We are now getting more of our calories from fats and less from carbohydrates. In 1909–13, dietary fat in the food supply averaged 126 grams per person per day; in 1935–39, 133 grams, and by 1956, 148 grams. Some of the increased intake of fat comes from greater use of meat, poultry, fish, and salad dressings.

Our sources of protein have shifted. In 1909, our most important source was flour and cereal products because they formed such a large share of our food supply. Today, they rank third as protein suppliers. Meat, poultry, and fish are first, and dairy products are second. The amount of available protein per person has fluctuated and now stands slightly lower than in 1909.

The increasing consumption of milk has meant more calcium and riboflavin. Milk products (excluding butter) now provide three-fourths of the calcium and about one-half of the riboflavin in the food supply.

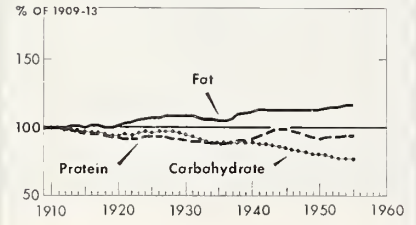
B vitamins and iron increase

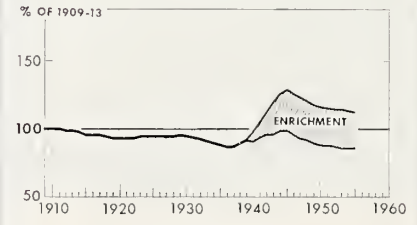
Bread and flour enrichment and greater use of meat and poultry have increased our supplies of the B vitamins and iron. The increase has been counterbalanced somewhat by the decrease in consumption of grain products—important sources of these nutrients even before enrichment—and of dry beans and nuts.

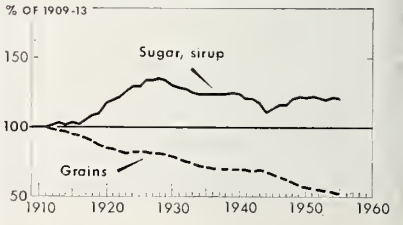
Large increases in use of green and yellow vegetables added to vitamin A supplies and, with citrus fruits and tomatoes, gave a large and steady upward trend in vitamin C values from 1909 to 1946. Since 1946, the decrease in total consumption of fruits and vegetables has reduced amounts of these nutrients.

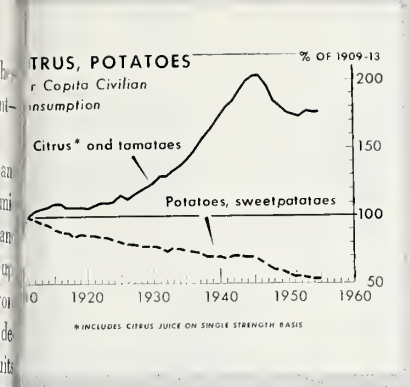
Food supplies analyzed yearly

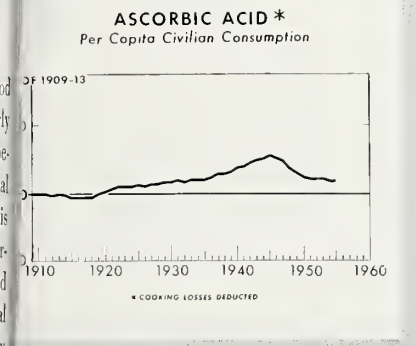
Information on the national food supply has been compiled yearly since 1909 by USDA commodity specialists. They add together the total quantities of food produced in this country each year, the quantities carried over from the previous year, and all imported foods. From this total they deduct the quantities taken by the Armed Forces, exported, used for feed, seed, or other nonfood purposes, and left over at the end of the year. Estimated losses in distribution channels are also deducted. The remaining food is considered to have "disappeared" into civilian channels and to approximate annual consumption. This represents economic consumption rather than food actually eaten, since the food is measured at the retail level.☆

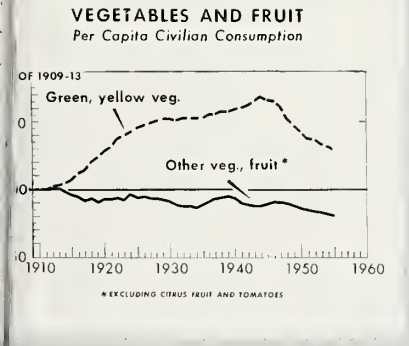


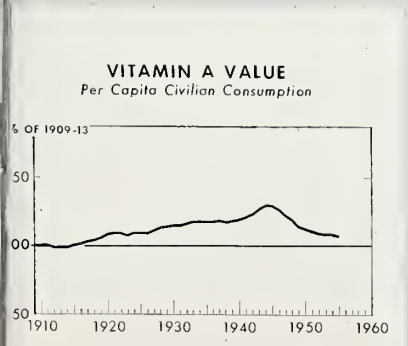












How much ALFALFA for Poultry?

■ Alfalfa meal is an important component of poultry feeds. USDA research indicates how much we can increase the meal content in these feeds without adverse effects from alfalfa saponin on laying hens.

ARS poultry husbandman B. W. Heywang has already found, for example, that while the saponin in alfalfa does decrease egg production and diet consumption of laying hens, this happens *only* while the meal is being fed and *only* if high enough levels are fed. The undesirable results disappear as soon as the high-saponin meal is discontinued.

Work indicates that these ill effects probably wouldn't occur at the level alfalfa meals are normally fed, although the meals vary greatly in saponin content and thus in their retarding effect. (These amounts are generally within smaller limits than those used in the tests.)

Poultry researchers have known for some time that dehydrated alfalfa meals unusually high in saponin can depress growth, diet consumption, and feed utilization of chicks, and egg production of layers. More recent evidence indicates that sun-cured alfalfa meals have the same effects. Saponin—a glucoside commonly found in many plants—has generally been pinpointed as the cause of the damage. There has been some conflicting evidence, however, as to saponin's role in producing this damage. So USDA scientists set up feeding trials with saponin from two sources to check its effects on laying hens.

With the cooperation of biochemist A. R. Kemmerer, of the University of Arizona, and ARS chemist C. R. Thompson, Heywang conducted 2 saponin feeding trials of 50 days each at the Southwest Poultry Experiment Station, Glendale, Ariz.

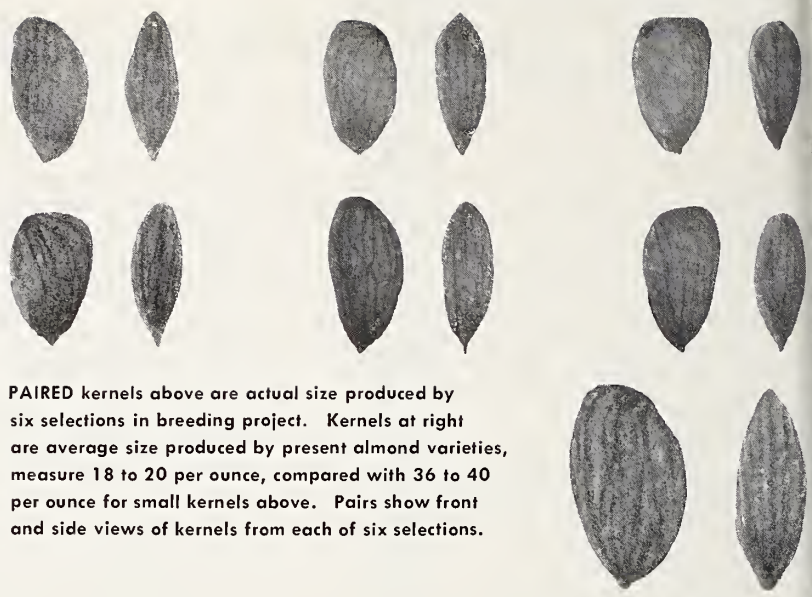
White Leghorns, individually caged and all laying at about the same rate, were fed diets containing no saponin. Then in the first experiment, the hens were placed on a diet containing either 0.4 percent saponin extracted from alfalfa, or one containing 0.26 percent saponin supplied by sun-cured alfalfa meal. In the second experiment, birds on the saponin diets were put back on a saponin-free diet, and the birds on a saponin-free diet were given saponin.

Both levels of saponin decreased egg production during both experiments, although birds on the alfalfa meal did better than those on the extracted alfalfa saponin. For example, birds on the meal laid about 73 percent as many eggs in the first experiment and 66 percent as many in the second, as those on a saponin-free diet. Hens fed the extracted saponin laid only about 51 percent as many eggs during the first experiment, and 43 percent as many during the second, as those without saponin. Neither diet, however, had any lasting harmful effect on egg production. Birds put back on a saponin-free diet were laying within 2 weeks at the same rate as before. Saponins in both experiments lowered diet consumption and body weight. But neither of the saponins had any effect on egg weight.

The growing importance of alfalfa as a crop and as a valuable source of vitamin A for laying hens assures continued use of the meal. Should we ever wish to increase the meal in the diet of laying hens, it will be vital to know just what the safe limitations are. Results of this and other work are helping to establish such limitations.☆

ALMONDS THAT FIT TODAY'S NEEDS

Breeders are developing trees yielding small, flat nut for candy industry



PAIRED kernels above are actual size produced by six selections in breeding project. Kernels at right are average size produced by present almond varieties, measure 18 to 20 per ounce, compared with 36 to 40 per ounce for small kernels above. Pairs show front and side views of kernels from each of six selections.

■ Breeding plants with *bigger* fruits is a typical research aim, but cooperative USDA and State research underway in California has the unusual goal of breeding almond trees that will produce *smaller* nuts. Nine promising selections are now being tested.

Small-sized, flat almond kernels have long been in great demand for specialty use by the country's candy industry. But no almond variety grown in the United States now consistently produces kernels of a size and shape to fit this special need.

Breeding for small kernels in almonds is complicated by the fact that kernel size is largely related to the vigor of the tree and the number of nuts produced per shoot or per unit of leaf area. With adverse crop conditions, a tree that normally bears numerous small nuts may set only a few nuts and, consequently, larger ones. Since the almond trees must be grown outdoors where environmental conditions can't be controlled, it may take several seasons to determine whether the size of the nuts produced by experimental selections is the result of genetic or of environmental factors.

Pomologist D. E. Kester, of the California Agricultural Experiment Station, Davis, and ARS horticulturist R. W. Jones, at Fresno, are studying selections from controlled crosses and from chance seedling trees of unknown parentage found about the State. What they're attempting to do is to develop a variety that will produce a large proportion of small kernels.

Breeding new varieties is long-term job

Like all tree-breeding efforts, production of new almond varieties is a long-term project. That's because of the time required from cross-pollination to development of the seed, and from growth of the seed into a tree mature enough to bear fruit. The researchers hasten this process somewhat by taking buds from young seedlings as soon as they develop and budding them on to branches of mature trees. In 2 or 3 years, the developing shoots are mature enough to bloom and bear fruit. After the production of two, three, or more crops, tentative selections for further trial are made, on the basis of growth, disease resistance, and nut characteristics. The almond breeding effort, begun over 10 years ago, is now at this stage.

Several promising selections under study

Kester and Jones have sifted out six promising selections from the controlled crosses for further study. In addition, selections from chance trees with the desirable kernel size and shape have been narrowed down at present to three, with a few more still too new for evaluation. All nine selections are now growing in plots throughout the almond-growing area and in experimental plots at Davis, Winters, and Fresno.

The next step will be to grow these selections on a small scale in orchards under commercial conditions, and compare them with standard varieties. Two of the selections may be placed in commercial orchards this year. A good season this summer could speed up evaluation of the other selections. These tests will determine the reliability of the selections in yield and disease resistance of the trees, and in size, shape, and appearance of the kernels. Interfertility of the selections with standard varieties is also important, because most almond varieties must be cross-pollinated.☆

Value of resistance

Stem nematodes (minute parasites) cut annual yields of Ranger alfalfa by 1½ tons per acre and, over a 5-year period, reduced plant stands 35 percent in cooperative experiments by USDA and the Nevada Agricultural Experiment Station. Yields and stands of the resistant Lahontan variety were not affected.

In infested fields, susceptible Ranger averaged less than 4¼ tons per acre, Lahontan, 6 tons. In plots free of stem nematodes, Ranger averaged 6½ tons and Lahontan, 6¾ tons.

Stem nematodes cause greatest injury in susceptible alfalfa by infesting young crown buds and preventing new growth. Plants are dwarfed, have few branches, and die in a year or two. Sometimes the plants seem to recover and grow normally until conditions again favor the parasite. Stem nematodes also cause alfalfa plant crowns to rot. Weeds easily become established in thin stands of weak alfalfa plants.

Extent of damage to susceptible alfalfas, such as Ranger, depends on whether conditions favor stem nematode development and how long infestations have existed.

Better flaming pays

Careful adjustments and use of liquified petroleum gas burners for flame cultivation of cotton gave improved weed control in cooperative USDA-California station research.

Studies by three agricultural engineers—USDA's L. M. Carter, Shafter, Calif., and R. J. Colwick, State College, Miss., and California's J. R. Tavernetti, at Davis—showed that equipment must also be used carefully to prevent formation of ridges, clods, and depressions between rows. These irregularities, and wind, can deflect the flame and seriously damage cotton plants, especially those less than 10 inches high.

Carter says that most burners now available will give satisfactory weed control, provided the recommendations for proper use are followed.

Flame cultivation, often used to supplement mechanical and chemical cultivation, consists of applying controlled fire along rows to kill weeds before they're established. Tractor-drawn flame equipment normally treats several rows at one time.

Screwworms found

Screwworms discovered infecting livestock on a farm in Highlands County, Fla., June 17 and a few flies caught earlier in traps elsewhere mean we still have a few flies despite a gigantic eradication effort.

This was the first animal infestation identified since Feb. 19, 1959. The eradication effort was intensified in the area of the latest infestation. Fifty million sterile flies are released weekly over the original infestation area to thwart reproduction of native flies (AGR. RES., July 1958, p. 8). And several hundred baited traps are double checking effectiveness of the eradication effort.

Final success of this advanced stage of eradication depends more than ever on southeastern livestock producers looking for and reporting infestations. Larva and egg specimens from wounds should be furnished to eradication headquarters in Sebring.

Radio waves that kill

Heat from radio-frequency electric fields kills in seconds rice and granary weevils, flour beetles, dermestid beetles, and lesser grain borers in stored wheat and wheat shorts.

In research by USDA and the Kansas and Nebraska Agricultural Experiment Stations, wheat was given brief exposures to radio frequencies of 10 to 39 megacycles per second and field intensities of 1.2 to 3.6 kilovolts per inch. The resultant temperatures of 140° to 150° F. required to kill the above insects didn't damage the wheat. To kill other insects that infest our stored grain, however, might take higher temperatures.

This method has not been used in industry yet because of high cost. The present experimental unit, adapted from components available on the market, has a low capacity of 400 bushels per hour. Cost of large-scale treatment is estimated at 3½ cents a bushel—far more than fumigation costs. A commercially practical adaptation of the method is being

sought, however, by the researchers. These men hope that this can be accomplished through equipment development.

Four foreign grants

Four grants for research abroad—two to Finland and two to Great Britain—were just made by USDA under its recent foreign research program.

Largest grant of $253,000 went to the Biochemical Institute, Helsinki, Finland, for basic work on flavor transmission from dairy feed to milk. The other Finnish grant went to the Research Institute of Meat Technology, at Hameenlinna, for study of influence of beneficial microorganisms on flavor development and other

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chemical changes in dry sausage, and effects on spoilage organisms.

One British grant went to the Shirley Institute of the British Cotton Industry Research Association, in Manchester, for basic study leading to improvement of flame-resistant treatments for cotton. The other went to the National Institute for Research in Dairying, at Reading, for study of microorganisms responsible for flavor development in cheese and other cultured milk products.

Research abroad is being paid for with foreign currencies accruing in various countries from sale of surplus agricultural commodities under Public Law 480. The Forest Service, Agricultural Marketing Service, and ARS are USDA agencies participating in this foreign research plan.

Corn borer is costly

More than 100 million bushels of U.S. corn—about 2.9 percent of the crop—were lost to the European corn borer in 1958. However, this loss is only half of the 1957 toll and only slightly higher than the three lowest losses in the past 10 years.

Nevertheless, last year's damage cost about $98 million, enough to buy

about 437,000 acres of good Corn Belt land. Iowa lost the most, 40½ million bushels, Nebraska, 23 million, and Illinois, 14 million. This is a joint State-Federal estimate from surveys made last fall.

The borer cuts crop yield, lowers quality, increases production and harvesting costs, and is costly to keep in check. Entomologists say that each borer cuts a corn plant's production by about 3 percent.

Saving floodwaters

Much of the limited rainfall—now being almost totally lost through runoff—that occurs in the Southwest might be held in the area in which it falls, USDA research shows.

ARS agricultural engineers R. V. Keppel and J. E. Fletcher have found that the annual precipitation of 7 to 15 inches in the Tucson, Ariz., area falls largely in the summer and winter, and much of it in small, local but intense thunderstorms. About 95 percent of the water from intense storms promptly runs off. Steep slopes and straight stream channels develop high water velocities and heavy sediment. The water runs into the river channels in abrupt wave movements, causing flash floods.

In Walnut Gulch watershed near Tombstone, Ariz., a dry streambed became a raging torrent in 17 minutes of rainfall, with 20,000 cubic feet of water racing by per second.

Although runoff can never furnish much water in this area, Keppel and Fletcher have observed that beneficial savings can be made in two ways. Small reservoirs on tributaries of larger streams—located where water can get into underground storage

areas—could recover water (Agr. Res., January 1959, p. 8). And improved vegetative cover in the area could hold some of the water too, improving soil tilth and infiltration, and reducing surface puddling.

Adjust seeding rate

Smaller crop stands grown from seeds treated with insecticides may be caused by decreased seed flow through drill (planters) rather than reduced germination resulting from the chemical treatment.

Cooperative work by USDA and the Oklahoma Agricultural Experiment Station showed that insecticide treatment causes a smaller rate of flow and fewer seeds per acre. Farmers were advised by the scientists to allow for the smaller seed flow and enlarge the opening in the seed-hopper floor in order to increase the flow.

The scientists found no difference in the rate of germination, by laboratory test, of treated and untreated seed. The treated seed, however, weighed about 2 or 3 pounds less per bushel than the untreated seed. The kind and amount of insecticide used affected rate of seed flow, varying from 9 to 21 percent below that of the untreated seed.